

Introduction

The latest routine international evaluation for females fertility traits took place as scheduled at the Interbull Centre. Data from twentyone (21) countries were included in this evaluation.

International genetic evaluations for female fertility traits of bulls from Australia, Austria, Belgium, Canada, Czech Republic, Denmark-Finland-Sweden, France, Germany, Ireland, Israel, Italy, Netherlands, New Zealand, Norway, Poland, Spain, Switzerland, South Africa, the United Kingdom, Uruguay, Japan and the United States of America and Slovenia were computed. Brown Swiss, Guernsey, Holstein, Jersey, Red Dairy Cattle and Simmental breed data were included in this evaluation.

Based on a decision made by Interbull Steering committee in August 2007, female fertility traits are classified as follows:

- T1 (HC): Maiden (H)eifer's ability to (C)onceive. A measure of confirmed conception, such as conception rate (CR), will be considered for this trait group. In the absence of confirmed conception an alternative measure, such as interval first-last insemination (FL), interval first insemination-conception (FC), number of inseminations (NI), or non-return rate (NR, preferably NR56) can be submitted;
- T2 (CR): Lactating (C)ow's ability to (R)ecycle after calving. The interval calving-first insemination (CF) is an example for this ability. In the absence of such a trait, a measure of the interval calving-conception, such as days open (DO) or calving interval (CI) can be submitted;
- T3 (C1): Lactating (C)ow's ability to conceive (1), expressed as a rate trait. Traits like conception rate (CR) and non-return rate (NR, preferably NR56) will be considered for this trait group;
- T4 (C2): Lactating (C)ow's ability to conceive (2), expressed as an interval trait. The interval first insemination-conception (FC) or interval first-last insemination (FL) will be considered for this trait group. As an alternative, number of inseminations (NI) can be submitted. In the absence of any of these traits, a measure of interval calving-conception such as days open (DO), or calving interval (CI) can be submitted. All countries are expected to submit data for this trait group, and as a last resort the trait submitted under T3 can be submitted for T4 as well.
- T5 (IT): Lactating cow's measurements of (I)nterval (T)raits calving-conception, such as days open (DO) and calving interval (CI).

Based on the above trait definitions the following traits have been submitted for international genetic evaluation of female fertility traits.

Country	Traits	Submitted traits and their definitions
AUS	T4=C2 T5=IT	Calving interval converted to 42 days pregnancy rate Calving interval converted to 42 days pregnancy rate
BEL	T2=CY T4=C2 T5=IT	PR=Pregnancy Rate ($=\frac{21}{(DO-45+11)}*100$, with DO=days open) PR=Pregnancy Rate ($=\frac{21}{(DO-45+11)}*100$, with DO=days open) PR=Pregnancy Rate ($=\frac{21}{(DO-45+11)}*100$, with DO=days open)
CAN	T1=HC T2=CY T3=C1 T4=C2 T5=IT	NR=Non Return Rate after 56 Days in heifers (NRR), % CF=Interval from Calving to First Service in cows (CF) NR=Non Return Rate after 56 Days in cows (NRR), % FC=Interval first insemination-conception in cows DO=Days open
CHE	T1=HC T2=CR T3=C1 T4=C2	CR=Heifers' Conception rate CF=Interval from Calving to First Service (ICF), days NR=Non Return Rate after 56 Days (NRR), % FL=Interval from first to last insemination cows
CZE	T1=HC	CR=Heifers' Conception rate (pregnant or not after 3 months)

	T3=C1	CR=Cows' Conception rate (pregnant or not after 3 months)
	T4=C2	CR=Cows' Conception rate (pregnant or not after 3 months)
AUT/DEU	T1=HC	NR=Heifers' Non Return Rate after 56 days
	T2=CY	CF=Interval from calving to first insemination cows (days)
	T3=C1	NR=Cows' Non Return Rate after 56 days
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=Days open (days)
DFS	T1=HC	CR=Heifers' Conception rate for maiden heifers
	T2=CY	CF=Interval from calving to first insemination cows (days)
	T3=C1	CR=Cows' conception rate for cows
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=Days open (days)
ESP	T2=CY	Interval from Calving to First Service (ICF)
	T4=C2	Interval first insemination to conception
	T5=IT	Days Open
FRA	T1=HC	CR=Heifers' Conception rate (binary trait) for maiden heifers
	T2=CY	Interval between calving and first AI
	T3=C1	CR=Cows' Conception rate (binary trait)
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	FL=Interval from first to last insemination cows (days)
GBR	T2=CY	CI=days between 1st and 2nd calvings
	T3=C1	NR=1st lactation non return at 56 days
	T4=C2	CI=days between 1st and 2nd calvings
	T5=IT	CI=days between 1st and 2nd calvings
IRL	T2=CY	CI=Calving interval
	T4=C2	CI=Calving interval
	T5=IT	CI=Calving interval
ISR	T3=C1	CR=Inverse of the number of insemination to conception (%)
	T4=C2	CR=Inverse of the number of insemination to conception (%)
ITA	T1=HC	NR= non-return rate 56 days (heifers)
	T2=CY	CF=Days to first service
	T3=C1	CR=Conception rate at first service
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	DO=days open (days)
ITA(BSW)	T1=HC	CR=Conception rate
	T2=CY	CF=Interval calving to first insemination
	T3=C1	CR=Conception rate
	T4=C2	DO=Days Open
	T5=IT	CI=Calving interval
NLD	T1=HC	CR=Heifers' Conception rate
	T2=CY	CF=Interval calving to first insemination (days)
	T3=C1	CR=Cows' Conception rate (binary trait) for cows
	T4=C2	FL=Interval from first to last insemination cows (days)
	T5=IT	CI=Days Open
NOR	T1=HC	NI=Number of inseminations (heifers)
	T2=CY	CF=Days from calving to first insemination (days)
	T3=C1	NI=Number of inseminations (cows)
	T4=C2	NI=Number of inseminations (cows)
	T5=IT	CF=Days from calving to first insemination (days)
NZL	T2=CY	PM=Lactating cow's ability to start cycling
	T4=C2	PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), (in days)
	T5=IT	PR42: confirmed pregnant within 6 weeks of planned start of mating (PSM), (in days)
POL	T1=HC	CR=Conception Rate (heifer)
	T2=CR	CF=Interval from calving to first insemination
	T3=C1	CR=Conception Rate (cow)
	T4=IT	DO=Days open

	T5=IT	DO=Days open
URY	T4=C2	Days open expressed as Daughter Pregnancy Rate
	T5=IT	Days open expressed as Daughter Pregnancy Rate
USA	T1=HC	CR=Conception rate (heifer)
	T2=CY	CF=Interval from calving to first insemination
	T3=C1	CR=Conception rate (cow)
	T4=C2	DP=Daughter Pregnancy Rate
	T5=IT	DP=Daughter Pregnancy Rate
ZAF	T4=IT	CI=Calving Interval
	T5=IT	CI=Calving Interval
JPN	T1=HC	CR=Heifers' Conception rate
	T3=C1	CR=Cows' Conception rate
	T4=C2	DO=Days open
	T5=IT	DO=Days open
SVN	T5=IT	CI=Calving interval (days)

 CHANGES IN NATIONAL PROCEDURES

Changes in the national genetic evaluation of female fertility traits are as follows:

AUS (GUE,HOL,JER,RDC) Drop in information due to data clean up and pedigree editing.
 Some bulls not longer qualified due to loss of herds.

BEL (HOL) Drop in daughters, herds, EDC and reliabilities due to corrections in pedigree.
 Missing bulls because the pedigree correction removed number of herds and daughters.

CHE (ALL) Change in number of herds, EDC and reliabilities due to manual data edits and hYS assignment.

DEU (HOL) Overall base change. From this routine run onwards cow base is adjusted with each routine run, four months (birth month) forwards.
 Some bulls changing from official to unofficial due to decrease in number of herds.

DFS (HOL,JER,RDC) Drop in EDC mostly cause by rounding effect.

ESP (HOL) Base changed. Drop in information due to new checks in data editing.

IRL (HOL,JER,RDC) Drop in information due to correction in the pedigree based on genomic information.

JPN (HOL) Changes in EDC due to pedigree editing.

NLD (ALL) Drop in information due to pedigree corrections.

POL (HOL) The Polish Federation of Cattle Breeders and Milk Producers replaced the milk recording system SYMLEK by the FEDINFO system.
 Due to this change, a marginal number of animals have been assigned to a native breed instead of Holstein-Friesian.
 These bulls were removed from the evaluation.

USA (ALL) Drop in information due to pedigree corrections and herd-year edits.
 Missing bulls due to loss of herds which led to their no longer being qualified.

INTERBULL CHANGES COMPARED TO THE PREVIOUS ROUTINE RUN

In 2020 new post-processing windows\200\231 correlations for all breeds and traits have been applied: the upper bounds have been set to 0.99 as these were judged to have very little effect on evaluations while the lower values have been reduced to the 10th percentile. This reduction would provide post-processed correlations to be closer to the real estimated ones. The previously lower value adopted (based on the 25th percentile) had been found too high causing estimated and post-processed correlations to differ significantly from each other. It is a recommendation from the Interbull Technical Committee to review such windows every 5 years. The weight assigned to the magnitude of the changes tested by each country has also been revised. The new weight will allow post-processed correlations to take more in consideration the value of the new estimated ones even when no changes are applied by the countries. More information can be read on https://interbull.org/ib/rg_procedure

Since 2021 a new trait group has been added to the MACE evaluation, called stcm (SNP Training for clinical mastitis) evaluating the trait cma (pure clinical mastitis). New trait group codes have been issued as follows: 041 for international ebv files (.itb), 071 for parent average (ipr).

DATA AND METHOD OF ANALYSIS

Data were national genetic evaluations of AI sampled bulls with at least 10 daughters or 10 EDC (for clinical mastitis and maternal calving traits at least 50 daughters or 50 EDC, and for direct calving traits at least 50 calvings or 50 EDC) in at least 10 herds. Table 1 presents the amount of data included in this Interbull evaluation for all breeds.

National proofs were first de-regressed within country and then analysed jointly with a linear model including the effects of evaluation country, genetic group of bull and bull merit. Heritability estimates used in both the de-regression and international evaluation were as in each country's national evaluation.

Table 2 presents the date of evaluation as supplied by each country

Estimated genetic parameters and sire standard deviations are shown in APPENDIX I and the corresponding number of common bulls are listed in APPENDIX II.

SCIENTIFIC LITERATURE

The international genetic evaluation procedure is based on international work described in the following scientific publications:

International genetic evaluation computation:
Schaeffer. 1994. J. Dairy Sci. 77:2671-2678
Klei, 1998. Interbull Bulletin 17:3-7

Verification and Genetic trend validation:
Klei et al., 2002. Interbull Bulletin 29:178-182.
Boichard et al., 1995. J. Dairy Sci. 78:431-437

Weighting factors:
Fikse and Banos, 2001. J. Dairy Sci. 84:1759-1767

De-regression:
Sigurdsson and G. Banos. 1995. Acta Agric. Scand. 45:207-219
Jairath et al. 1998. J. Dairy Sci. Vol. 81:550-562

Genetic parameter estimation:
Klei and Weigel, 1998, Interbull Bulletin 17:8-14
Sullivan, 1999. Interbull Bulletin 22:146-148

Post-processing of estimated genetic correlations:
Mark et al., 2003, Interbull Bulletin 30:126-135
Jorjani et al., 2003. J. Dairy Sci. 86:677-679
<https://wiki.interbull.org/public/rG%20procedure?action=print>

Time edits
Weigel and Banos. 1997. J. Dairy Sci. 80:3425-3430

International reliability estimation
Harris and Johnson. 1998. Interbull Bulletin 17:31-36

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for the next routine evaluation can be found on
<http://www.interbull.org/ib/servicecalendar>.

NEXT TEST INTERNATIONAL EVALUATION

Dates for the next test run can be found on
<http://www.interbull.org/ib/servicecalendar>.

PUBLICATION OF INTERBULL ROUTINE RUN

Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimizing the need to resort to

conversions.

At the same time, all recipients of Interbull results are expected to honor the agreed code of practice, decided by the Interbull Steering Committee, and only publish international evaluations on their own country scale. Evaluations expressed on another country scale are confidential and may only be used internally for research and review purposes.

PUBLICATION OF INTERBULL TEST RUN

Test evaluation results are meant for review purposes only and should not be published.

^LTable 1. National evaluation data considered in the Interbull evaluation for fertility (August Routine Evaluation 2024). Number of records for lactating cow's ability to conceive (cc2) by breed

Country	BSW	GUE	HOL	JER	RDC	SIM
AUS		151	8865	1884	810	
BEL			2162			
CAN	186	50	10591	671	609	
CHE	3076		3369			
CZE			3539			
DEA	5015					
DEU			26037		325	
DFS			17684	2543	10755	
ESP			6901			
EST						
FRA	444		17453			
FRM						
GBR	115	255	7814	651	485	
HUN						
IRL			3479	260	78	
ISR			1718			
ITA	2022		7419			
JPN			6813			
KOR						
LTU						
LVA						
NLD	236		16930	271	104	
NOR					3168	
NZL	54	50	8749	5009	1339	
POL			9530			
PRT						
SVK						
SVN						
URY			2057			
USA	1222	807	42949	5481	809	
ZAF			1277	757	160	
HRV						
CAM						
No. Records	12370	1313	205336	17527	18642	
Pub. Proofs	10854	1084	161253	14528	18371	0

^LAPPENDIX I. Sire standard deviations in diagonal and genetic correlations below diagonal

BSW	hco						
	CAN	DEA	FRA	USA	CHE	NLD	ITA
CAN	9.41						
DEA	0.86	9.87					

FRA	0.76	0.90	0.76						
USA	0.79	0.80	0.86	2.59					
CHE	0.91	0.95	0.87	0.81	13.16				
NLD	0.83	0.72	0.80	0.81	0.77	4.36			
ITA	0.79	0.80	0.89	0.90	0.87	0.84	15.55		

BSW crc

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	7.24								
CHE	0.80	11.37							
DEA	0.77	0.95	15.02						
NLD	0.82	0.85	0.83	3.56					
NZL	0.59	0.65	0.76	0.61	0.12				
USA	0.77	0.83	0.80	0.78	0.61	8.15			
GBR	0.70	0.69	0.62	0.73	0.65	0.73	3.93		
FRA	0.82	0.97	0.96	0.86	0.66	0.85	0.73	1.69	
ITA	0.82	0.84	0.86	0.81	0.61	0.79	0.72	0.87	17.00

BSW cc1

	CAN	CHE	DEA	NLD	USA	GBR	FRA	ITA
CAN	7.38							
CHE	0.83	11.72						
DEA	0.79	0.95	11.45					
NLD	0.76	0.70	0.67	3.75				
USA	0.75	0.67	0.67	0.80	2.85			
GBR	0.77	0.81	0.79	0.70	0.68	0.03		
FRA	0.73	0.69	0.67	0.82	0.86	0.71	0.88	
ITA	0.68	0.66	0.66	0.69	0.78	0.67	0.88	16.25

BSW cc2

	CAN	CHE	DEA	NLD	NZL	USA	GBR	FRA	ITA
CAN	6.76								
CHE	0.77	11.11							
DEA	0.75	0.93	12.30						
NLD	0.83	0.79	0.75	3.22					
NZL	0.65	0.81	0.68	0.64	0.09				
USA	0.81	0.82	0.82	0.79	0.65	2.51			
GBR	0.70	0.80	0.79	0.73	0.67	0.81	3.93		
FRA	0.86	0.89	0.89	0.83	0.66	0.84	0.79	0.88	
ITA	0.85	0.85	0.85	0.76	0.74	0.77	0.74	0.90	19.28

BSW int

	CAN	DEA	NLD	NZL	USA	GBR	ITA	SVN
CAN	7.64							
DEA	0.79	14.35						
NLD	0.84	0.86	3.10					
NZL	0.66	0.67	0.65	0.09				
USA	0.90	0.81	0.78	0.61	2.51			
GBR	0.82	0.70	0.82	0.68	0.82	3.93		
ITA	0.86	0.88	0.79	0.67	0.74	0.80	19.32	
SVN	0.72	0.68	0.72	0.68	0.70	0.75	0.71	19.49

GUE crc

	CAN	GBR	NZL	USA	AUS
CAN	7.72				
GBR	0.73	4.76			
NZL	0.59	0.65	0.11		
USA	0.77	0.76	0.60	6.99	
AUS	0.67	0.78	0.90	0.66	6.97

JER crc							
	CAN	DFS	GBR	NLD	NZL	USA	IRL
CAN	6.97						
DFS	0.81	13.36					
GBR	0.65	0.81	3.82				
NLD	0.82	0.84	0.69	3.41			
NZL	0.58	0.65	0.63	0.55	0.07		
USA	0.77	0.81	0.78	0.77	0.63	8.33	
IRL	0.61	0.61	0.79	0.60	0.57	0.60	2.40

JER cc1					
	CAN	DFS	GBR	NLD	USA
CAN	6.94				
DFS	0.71	15.46			
GBR	0.78	0.67	0.03		
NLD	0.75	0.76	0.69	3.58	
USA	0.75	0.80	0.67	0.71	2.90

JER cc2									
	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL
CAN	6.68								
DFS	0.80	15.63							
GBR	0.70	0.74	3.82						
NLD	0.82	0.80	0.72	3.18					
NZL	0.64	0.64	0.64	0.64	0.05				
USA	0.80	0.78	0.77	0.77	0.68	2.65			
ZAF	0.66	0.66	0.73	0.67	0.74	0.84	11.27		
AUS	0.64	0.64	0.64	0.64	0.63	0.65	0.70	6.50	
IRL	0.75	0.73	0.76	0.75	0.66	0.76	0.78	0.72	2.40

JER int									
	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL
CAN	6.61								
DFS	0.83	15.33							
GBR	0.75	0.82	3.82						
NLD	0.82	0.82	0.77	3.14					
NZL	0.62	0.61	0.64	0.61	0.05				
USA	0.83	0.80	0.77	0.75	0.67	2.65			
ZAF	0.71	0.72	0.74	0.71	0.75	0.84	11.27		
AUS	0.68	0.67	0.68	0.67	0.63	0.68	0.71	6.50	
IRL	0.79	0.73	0.75	0.75	0.63	0.76	0.80	0.75	2.40

RDC hco						
	CAN	DEU	DFS	NOR	USA	NLD
CAN	7.90					
DEU	0.90	14.37				
DFS	0.71	0.82	12.21			
NOR	0.83	0.87	0.87	16.59		
USA	0.83	0.83	0.82	0.73	2.76	
NLD	0.84	0.86	0.81	0.66	0.82	5.66

RDC crc									
	CAN	DEU	DFS	GBR	NOR	NZL	USA	NLD	IRL
CAN	6.64								
DEU	0.83	10.05							
DFS	0.84	0.89	12.70						

GBR	0.77	0.71	0.69	4.14							
NOR	0.83	0.81	0.85	0.61	14.22						
NZL	0.66	0.58	0.55	0.67	0.58	0.11					
USA	0.77	0.82	0.80	0.75	0.77	0.66	8.52				
NLD	0.83	0.84	0.88	0.72	0.79	0.56	0.77	3.33			
IRL	0.60	0.60	0.62	0.81	0.61	0.60	0.62	0.60	2.87		

RDC cc1

	CAN	DEU	DFS	GBR	NOR	NLD	USA				
CAN	7.49										
DEU	0.90	13.84									
DFS	0.70	0.81	12.98								
GBR	0.77	0.79	0.67	0.03							
NOR	0.78	0.86	0.93	0.77	14.10						
NLD	0.77	0.79	0.84	0.70	0.69	3.86					
USA	0.82	0.75	0.77	0.68	0.73	0.82	2.79				

RDC cc2

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	6.98										
DEU	0.92	11.43									
DFS	0.80	0.93	12.85								
GBR	0.70	0.76	0.75	4.14							
NOR	0.78	0.81	0.89	0.72	14.10						
NZL	0.64	0.67	0.64	0.66	0.66	0.07					
USA	0.87	0.89	0.79	0.79	0.72	0.65	2.57				
ZAF	0.69	0.81	0.73	0.70	0.78	0.65	0.80	17.07			
NLD	0.86	0.94	0.87	0.73	0.75	0.67	0.81	0.75	3.37		
AUS	0.66	0.68	0.63	0.67	0.65	0.64	0.68	0.66	0.65	7.64	
IRL	0.75	0.79	0.76	0.80	0.72	0.72	0.78	0.83	0.78	0.79	2.87

RDC int

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	6.70										
DEU	0.90	11.22									
DFS	0.87	0.94	13.19								
GBR	0.82	0.85	0.80	4.14							
NOR	0.77	0.74	0.68	0.69	14.22						
NZL	0.69	0.63	0.60	0.66	0.63	0.07					
USA	0.91	0.89	0.76	0.80	0.69	0.63	2.57				
ZAF	0.79	0.84	0.76	0.74	0.81	0.65	0.81	17.07			
NLD	0.87	0.90	0.92	0.82	0.73	0.62	0.79	0.80	3.16		
AUS	0.70	0.70	0.68	0.69	0.69	0.64	0.70	0.73	0.67	7.64	
IRL	0.81	0.81	0.78	0.80	0.69	0.71	0.77	0.85	0.79	0.80	2.87

^LAPPENDIX II. Number of common bulls

BSW

common bulls below diagonal
common three quarter sib group above diagonal

	CAN	DEA	FRA	USA	CHE	NLD	ITA				
CAN	0	108	55	112	111	35	100				
DEA	94	0	204	201	628	152	531				
FRA	47	155	0	76	172	80	183				
USA	101	160	57	0	212	57	143				
CHE	93	530	131	177	0	110	462				
NLD	31	142	67	53	104	0	127				
ITA	86	416	141	103	404	101	0				

BSW

```

-----
common bulls below diagonal
common three quarter sib group above diagonal
  CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
-----
CAN   0  127  123  41   20  140  49   74  118
CHE  106   0  630  116  31  279  64  172  490
DEA  109  523   0  167  44  249  60  212  653
NLD   36  107  153   0   29   69  35   84  140
NZL   19   24   38   22   0   21  15   22   36
USA  136  245  199  63  18   0   67  97  185
GBR   44   48   43  30  11  64   0   47   69
FRA   63  129  161  69  17  66  37   0  193
ITA  103  427  533  117  30  133  48  148   0
-----

```

```

BSW
-----
common bulls below diagonal
common three quarter sib group above diagonal
  CAN  CHE  DEA  NLD  USA  GBR  FRA  ITA
-----
CAN   0  129  124  42  141  49  78  120
CHE  108   0  629  116  279  69  180  491
DEA  110  520   0  168  249  66  224  653
NLD   37  107  153   0   69  38  88  141
USA  137  245  199  63   0  70  102  185
GBR   44   52  47  32  67  0  54  75
FRA   67  136  172  74  72  44  0  205
ITA  105  430  532  116  133  51  160   0
-----

```

```

BSW
-----
common bulls below diagonal
common three quarter sib group above diagonal
  CAN  CHE  DEA  NLD  NZL  USA  GBR  FRA  ITA
-----
CAN   0  113  109  37  15  133  46  71  102
CHE  94   0  621  116  26  336  64  180  460
DEA  97  516   0  168  35  325  60  223  601
NLD  33  107  153   0  23  92  35  88  138
NZL  14  21  32  18  0  24  12  19  26
USA  125  312  282  80  21  0  77  122  230
GBR  40  48  43  30  8  73  0  50  66
FRA  62  136  171  74  15  86  41  0  202
ITA  90  395  474  112  22  159  45  154  0
-----

```

```

BSW
-----
common bulls below diagonal
common three quarter sib group above diagonal
  CAN  DEA  NLD  NZL  USA  GBR  ITA  SVN
-----
CAN   0  114  39  15  138  48  113  28
DEA  101   0  167  35  324  60  721  84
NLD  35  153   0  23  92  35  146  42
NZL  14  32  18  0  24  12  29  9
USA  130  282  80  21  0  77  255  34
GBR  42  43  30  8  73  0  71  16
ITA  99  640  121  25  182  51  0  82
SVN  26  79  42  9  30  13  79  0
-----

```

```

GUE
-----
GUE
-----
common bulls below diagonal
common three quarter sib group above diagonal
  CAN  GBR  NZL  USA  AUS
-----

```

CAN	0	19	3	44	18
GBR	16	0	14	58	28
NZL	2	12	0	10	26
USA	43	54	7	0	19
AUS	13	22	23	16	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal
CAN GBR USA

CAN	0	20	44
GBR	16	0	63
USA	43	59	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal
CAN GBR NZL USA AUS

CAN	0	14	1	41	25
GBR	11	0	12	87	38
NZL	1	10	0	24	22
USA	39	88	23	0	71
AUS	21	31	21	68	0

GUE

common bulls below diagonal
common three quarter sib group above diagonal
CAN GBR NZL USA AUS

CAN	0	14	1	41	25
GBR	11	0	12	87	38
NZL	1	10	0	24	22
USA	39	88	23	0	71
AUS	21	31	21	68	0

HOL

common bulls below diagonal
common three quarter sib group above diagonal
CAN CZE DEU DFS FRA USA POL CHE NLD ITA JPN

CAN	0	1160	2408	1520	1353	3205	1521	884	1543	1753	1211
CZE	871	0	1931	1323	1248	1578	1314	509	1562	1263	852
DEU	2010	1489	0	2831	2437	3169	2569	1200	3324	2470	1389
DFS	1453	909	2227	0	1746	1923	1614	779	2372	1512	1036
FRA	1048	782	1438	1062	0	1736	1609	744	2022	1511	1161
USA	3701	1313	2611	1803	1081	0	2243	945	2063	2387	1548
POL	1427	1077	2349	1391	1150	2415	0	592	1810	1647	901
CHE	809	355	1129	732	691	875	494	0	950	653	483
NLD	1538	1359	3004	2111	1379	1887	1674	945	0	1605	1124
ITA	1401	866	1560	1123	799	1883	1338	560	1203	0	1070
JPN	714	394	657	568	446	860	514	315	601	510	0

HOL

common bulls below diagonal
common three quarter sib group above diagonal
BEL CAN CHE DEU DFS ESP GBR IRL ITA NLD NZL USA POL FRA

BEL	0	829	641	1306	935	977	930	559	653	1334	542	895	641	1020
CAN	833	0	923	2589	1609	1747	1786	623	1627	1696	761	3423	1413	1459
CHE	653	856	0	1246	789	779	811	463	620	1008	451	1007	561	759
DEU	1346	2119	1181	0	3020	2511	2434	1012	2161	3859	1098	3481	2330	2680
DFS	884	1543	748	2329	0	1716	1759	837	1317	2434	920	2081	1469	1763

ESP	1052	1577	732	2253	1560	0	1650	771	1438	1960	787	2081	1428	1908
GBR	918	1874	776	1910	1423	1514	0	1109	1364	2059	1038	2273	1241	1694
IRL	552	619	475	894	713	790	1160	0	482	1020	829	765	474	805
ITA	640	1396	555	1472	1099	1205	1087	419	0	1464	499	2266	1418	1294
NLD	1522	1713	1009	3638	2228	2060	1856	971	1256	0	1191	2345	1707	2164
NZL	442	698	375	853	670	654	901	728	404	1081	0	936	514	846
USA	857	4032	944	2790	1915	1907	2264	760	1846	2170	890	0	2043	1941
POL	554	1300	448	2036	1230	1227	1015	375	1143	1544	396	2110	0	1507
FRA	1013	1139	698	1578	1060	1844	1134	660	796	1464	523	1189	1040	0

HOL

common bulls below diagonal														
common three quarter sib group above diagonal														
	CAN	CHE	CZE	DEU	DFS	FRA	GBR	ISR	ITA	NLD	USA	POL	JPN	
CAN	0	924	1072	2576	1614	1468	1831	147	1634	1704	3462	1461	1372	
CHE	857	0	441	1236	789	762	818	65	620	1008	1007	586	519	
CZE	846	314	0	1620	1107	1004	952	124	1098	1378	1480	1259	749	
DEU	2109	1172	1318	0	3010	2694	2471	185	2150	3834	3454	2483	1594	
DFS	1547	748	869	2318	0	1769	1793	165	1317	2432	2086	1569	1101	
FRA	1156	704	653	1589	1071	0	1716	131	1299	2176	1952	1570	1300	
GBR	1939	786	687	1950	1455	1155	0	168	1391	2103	2348	1299	1185	
ISR	103	38	96	145	126	73	127	0	123	174	209	139	125	
ITA	1408	555	844	1463	1099	800	1127	83	0	1464	2266	1473	999	
NLD	1720	1009	1287	3612	2228	1484	1909	138	1256	0	2346	1832	1205	
USA	4079	944	1251	2763	1915	1208	2362	205	1846	2171	0	2110	1772	
POL	1363	484	1067	2275	1355	1108	1092	104	1208	1711	2210	0	915	
JPN	838	359	411	754	640	515	648	59	545	696	1022	535	0	

HOL

common bulls below diagonal																				
common three quarter sib group above diagonal																				
	BEL	CAN	CHE	CZE	DEU	DFS	ESP	FRA	GBR	IRL	ISR	ITA	NLD	NZL	USA	POL	ZAF	AUS	URY	JPN
BEL	0	818	641	543	1298	936	977	1015	932	561	86	653	1336	531	1047	633	335	791	368	556
CAN	822	0	915	1055	2505	1586	1731	1431	1756	611	144	1604	1666	712	3580	1379	448	1418	807	1270
CHE	653	841	0	441	1227	790	779	750	811	463	66	620	1008	440	1103	550	263	691	335	486
CZE	436	817	314	0	1617	1107	1093	995	939	424	124	1097	1378	471	1512	1177	267	697	484	720
DEU	1334	2016	1158	1307	0	2994	2510	2655	2422	1008	186	2143	3807	1053	4001	2272	561	1843	893	1505
DFS	884	1513	749	869	2296	0	1724	1756	1763	837	167	1318	2437	892	2474	1451	514	1406	709	1036
ESP	1052	1542	732	901	2241	1568	0	1906	1653	772	146	1438	1965	769	2398	1409	519	1297	725	1189
FRA	1004	1103	688	644	1533	1045	1827	0	1691	808	134	1282	2153	836	2640	1478	484	1377	628	1238
GBR	918	1838	776	679	1888	1423	1515	1125	0	1110	168	1364	2062	1006	2649	1225	507	1581	767	1121
IRL	552	600	475	328	888	713	790	656	1160	0	119	482	1023	817	928	464	339	819	413	490
ISR	51	100	38	96	143	126	112	72	124	93	0	123	176	123	234	130	61	125	94	124
ITA	640	1366	555	844	1450	1099	1205	785	1087	419	83	0	1462	478	2295	1389	269	941	544	949
NLD	1524	1674	1009	1287	3558	2230	2064	1446	1857	972	138	1255	0	1143	2915	1666	505	1609	761	1138
NZL	427	641	366	356	804	642	628	506	866	716	99	380	1031	0	1170	483	353	1271	572	585
USA	939	4129	1039	1271	3013	2053	2174	1478	2511	859	222	1865	2623	1116	0	2045	639	2157	1281	2066
POL	538	1247	435	953	1948	1202	1203	1006	994	364	91	1107	1485	365	2077	0	231	882	545	843
ZAF	281	411	222	190	429	380	476	337	446	297	39	205	421	282	614	160	0	479	318	414
AUS	690	1455	617	500	1413	1055	1074	953	1406	712	81	745	1406	1263	2221	681	419	0	726	949
URY	263	751	249	325	635	485	622	361	611	318	53	377	592	465	1547	421	267	564	0	607
JPN	356	704	312	371	646	559	588	449	563	308	50	484	601	287	887	454	260	513	307	0

HOL

common bulls below diagonal																		
common three quarter sib group above diagonal																		
	BEL	CAN	DEU	DFS	ESP	GBR	IRL	ITA	NLD	NZL	USA	POL	ZAF	AUS	URY	FRA	JPN	SVN
BEL	0	821	1296	936	977	932	561	652	1336	531	1047	632	335	791	368	1015	556	162
CAN	827	0	2511	1595	1737	1765	618	1607	1676	718	3594	1382	452	1426	813	1439	1275	210
DEU	1333	2026	0	2991	2509	2422	1008	2142	3804	1052	3995	2266	561	1842	893	2654	1505	342
DFS	884	1524	2293	0	1724	1763	837	1318	2435	892	2472	1450	514	1406	709	1756	1036	251
ESP	1052	1558	2241	1568	0	1653	772	1438	1963	769	2395	1409	519	1296	725	1905	1187	244
GBR	918	1851	1888	1423	1515	0	1110	1364	2062	1006	2649	1225	507	1581	766	1691	1121	206

IRL	552	609	888	713	790	1159	0	482	1022	817	928	464	339	819	413	808	490	114
ITA	640	1372	1450	1099	1205	1087	419	0	1463	478	2297	1387	269	941	544	1282	949	228
NLD	1524	1688	3556	2229	2064	1857	972	1256	0	1143	2914	1663	505	1609	761	2152	1137	270
NZL	427	646	804	642	628	865	715	380	1031	0	1170	483	353	1271	571	836	585	115
USA	939	4159	3013	2053	2174	2511	859	1867	2623	1116	0	2043	639	2157	1281	2640	2066	244
POL	538	1253	1944	1201	1203	994	364	1107	1485	365	2077	0	231	882	545	1478	842	256
ZAF	281	418	429	380	476	446	297	205	421	282	614	160	0	479	318	484	414	68
AUS	690	1460	1413	1055	1074	1406	712	745	1406	1263	2221	681	419	0	726	1377	949	158
URY	263	757	635	485	622	611	318	377	592	465	1547	421	267	564	0	628	607	92
FRA	1004	1111	1533	1045	1827	1125	656	785	1446	506	1478	1006	337	953	361	0	1238	199
JPN	356	707	646	559	588	563	308	484	601	287	887	454	260	513	307	449	0	156
SVN	125	163	333	198	216	152	88	192	233	78	199	210	48	110	46	145	84	0

JER

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS USA NLD

CAN	0	110	363	40
DFS	106	0	167	105
USA	355	157	0	81
NLD	33	102	80	0

JER

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NLD NZL USA IRL

CAN	0	117	163	48	179	415	14
DFS	111	0	193	172	176	188	61
GBR	163	188	0	107	245	238	91
NLD	42	172	101	0	99	110	42
NZL	181	152	250	91	0	323	156
USA	419	178	257	112	346	0	49
IRL	13	57	94	41	177	51	0

JER

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NLD USA

CAN	0	117	165	48	419
DFS	111	0	193	171	187
GBR	164	187	0	106	240
NLD	42	171	101	0	109
USA	424	178	259	112	0

JER

common bulls below diagonal
common three quarter sib group above diagonal
CAN DFS GBR NLD NZL USA ZAF AUS IRL

CAN	0	112	160	45	162	424	137	237	14
DFS	106	0	194	172	164	237	162	179	61
GBR	158	188	0	107	235	265	180	241	91
NLD	38	172	101	0	90	122	80	87	42
NZL	163	140	240	82	0	395	217	461	154
USA	429	215	292	127	468	0	330	533	55
ZAF	136	144	183	76	226	343	0	255	44
AUS	234	151	248	80	506	580	243	0	71
IRL	13	57	94	41	174	57	45	68	0

JER

common bulls below diagonal

common three quarter sib group above diagonal									
	CAN	DFS	GBR	NLD	NZL	USA	ZAF	AUS	IRL
CAN	0	114	161	45	164	428	139	239	14
DFS	108	0	194	172	164	237	162	179	61
GBR	160	188	0	107	235	265	180	241	91
NLD	39	172	101	0	90	122	80	87	42
NZL	166	140	240	82	0	395	217	461	154
USA	435	215	292	127	468	0	330	533	55
ZAF	138	144	183	76	226	343	0	255	44
AUS	237	151	248	80	506	580	243	0	71
IRL	13	57	94	41	174	57	45	68	0

RDC

common bulls below diagonal						
common three quarter sib group above diagonal						
	CAN	DEU	DFS	NOR	USA	NLD
CAN	0	10	187	7	110	6
DEU	10	0	67	17	22	14
DFS	197	58	0	138	177	61
NOR	6	16	117	0	74	44
USA	104	20	170	74	0	39
NLD	6	14	58	44	37	0

RDC

common bulls below diagonal									
common three quarter sib group above diagonal									
	CAN	DEU	DFS	GBR	NOR	NZL	USA	NLD	IRL
CAN	0	13	187	85	7	74	151	6	5
DEU	12	0	72	16	17	22	24	19	6
DFS	196	60	0	127	155	194	201	65	23
GBR	86	15	123	0	70	86	113	45	29
NOR	6	16	128	74	0	54	83	51	63
NZL	75	22	188	84	53	0	109	27	18
USA	147	22	197	108	83	111	0	45	32
NLD	6	19	62	44	51	26	43	0	14
IRL	5	6	18	28	62	17	32	14	0

RDC

common bulls below diagonal							
common three quarter sib group above diagonal							
	CAN	DEU	DFS	GBR	NOR	NLD	USA
CAN	0	13	188	85	7	6	151
DEU	12	0	71	16	17	19	24
DFS	197	59	0	128	142	65	201
GBR	86	15	124	0	78	46	113
NOR	6	16	119	82	0	49	83
NLD	6	19	62	45	49	0	45
USA	147	22	197	108	83	43	0

RDC

common bulls below diagonal											
common three quarter sib group above diagonal											
	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	0	13	185	80	7	69	175	78	6	77	5
DEU	12	0	70	16	17	20	25	3	19	48	6
DFS	193	59	0	127	142	178	225	63	65	235	23
GBR	81	15	123	0	69	79	126	47	45	95	29
NOR	6	16	119	73	0	44	88	0	49	76	63
NZL	69	20	174	76	43	0	119	40	23	151	17
USA	178	23	224	124	88	121	0	77	48	144	33

ZAF	83	3	60	44	0	38	72	0	3	46	4
NLD	6	19	62	44	49	23	46	3	0	42	14
AUS	79	46	212	93	65	151	146	48	40	0	23
IRL	5	6	18	28	62	17	33	4	14	22	0

RDC

common bulls below diagonal

common three quarter sib group above diagonal

	CAN	DEU	DFS	GBR	NOR	NZL	USA	ZAF	NLD	AUS	IRL
CAN	0	13	185	82	7	69	176	78	6	77	5
DEU	12	0	70	16	17	20	25	3	19	48	6
DFS	193	59	0	127	155	178	225	63	65	235	23
GBR	83	15	123	0	70	79	126	47	45	95	29
NOR	6	16	128	74	0	45	88	0	51	80	63
NZL	69	20	174	76	44	0	119	40	23	151	17
USA	179	23	224	124	88	121	0	77	48	144	33
ZAF	83	3	60	44	0	38	72	0	3	46	4
NLD	6	19	62	44	51	23	46	3	0	42	14
AUS	79	46	212	93	69	151	146	48	40	0	23
IRL	5	6	18	28	62	17	33	4	14	22	0

SIM

SIM

SIM

SIM

SIM

SIM